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Comparative measurements of inverse spin Hall effects and magnetoresistance in YIG/Pt and YIG/Ta

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Abstract

We report on a comparative study of spin Hall related effects and magnetoresistance in YIG|Pt and YIG|Ta bilayers. These combined measurements allow to estimate the characteristic transport parameters of both Pt and Ta layers juxtaposed to yttrium iron garnet (YIG): the spin mixing conductance G↑↓ at the YIG|normal metal interface, the spin Hall angle ΘSH, and the spin diffusion length λsd in the normal metal. The inverse spin Hall voltages generated in Pt and Ta by the pure spin current pumped from YIG excited at resonance confirm the opposite signs of spin Hall angles in these two materials. Moreover, from the dependence of the inverse spin Hall voltage on the Ta thickness, we extract the spin diffusion length in Ta, found to be λsdTa=1.8±0.7 nm. Both the YIG|Pt and YIG|Ta systems display a similar variation of resistance upon magnetic field orientation, which can be explained in the recently developed framework of spin Hall magnetoresistance.

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